**Wracksweeper: Project Design Specification**

**Capstone Team 3, Integrating A Side Scan Sonar System Into An AUV**

**Industry Sponsor:** Maritime Archaeological Society

**Faculty Adviser:** Dr. Martin Siderius

**Background:**

The Maritime Archaeological Society (MAS) is searching for a Spanish galleon, the Santo Christo de Burgos, which wrecked on the Oregon coast in 1693. Hundreds of artifacts including porcelain, beeswax, and teak timbers have been found on a section of shoreline. Over the past 10 years, MAS has been conducting sonar, magnetometer and diving searches for the wreck. The searches have been severely limited due to difficult ocean surface conditions in the search area. The small boats used for the surveys and dives must launch at very precise tide levels to access the site which is a 45 minute boat ride away. Once on site, rough seas and submerged rocks make the operations difficult and potentially dangerous to the crew.

**Problem:**

How can we conduct long duration side scan sonar surveys without tide limitations and without putting human crewmembers in potential danger?

**Objective:**

To facilitate the Maritime Archaeological Society’s search for the remains, it is necessary to outfit an unmanned underwater vehicle (UUV) owned by Portland State University’s NEAR lab with side-scan sonar, a rechargeable battery solution able to support at least 8 hours continuous operation, and sufficient (at least one) emergency location systems that a recovery team can track and rescue the vehicle in the event of mission failure. While the current mission is helping the Maritime Archeological Society, all upgrades to the system will be funded by the NEAR lab and the upgrades will benefit them for future research conducted with the UUV. To do this, a multi-disciplinary team consisting of Mechanical, Electrical, and Computer Engineers must specify and implement these systems. This principal objective can be subdivided into distinct subsystems which successfully achieved will in total comprise a successful solution: emergency location systems, side-scan sonar systems, power systems, and logistics systems. If the additional engineering resources exist, an additional wireless communications subsystem may be added to this roadmap.

**Constraints:**

For this project, all functions must be integrated onto the NEAR lab’s Riptide Systems UUV. New features must not in any way compromise the existing functionality of the UUV and must be removable to restore the UUV to its initial state. Payload components must fit within a bay 25.5” long with an internal diameter of 6.375”. The budgetary constraint is roughly $10,000, with changes to this conditional to the research value that can be added to the NEAR lab’s resources. Based on budget and project needs, we must design this system to use the already-purchased Imagenex OEM Ethernet Sidescan Sonar PCB kit, which expects sonar images to be obtained as .872 files using the Imagenex proprietary Windows-based software. This sonar system will require a computer capable of running that software, ethernet communication with the sonar, and a source capable of providing up to 2.5W power at between 22 and 33 VDC. Sonar imaging capabilities will be constrained by those of the Imagenex product, which allows imaging range scales from 10m to 200m and can provide transducer beam widths as narrow as 0.7x30 at 800 kHz and as wide as 2.2x75 at 260 kHz.

**Requirements:**

We have identified three tiers of project requirements; the *must* category is the minimum viable product necessary to achieve the basic objective, while the *should* category describes improvements which could benefit this specific project in a meaningful way and the *may* category describes features which allow the work of this project to be extensible to future research purposes. Though the objective is ultimately to find the shipwreck, a successful capstone completion does not require this; the successful additions of the necessary functionality to the UUV to enable finding the shipwreck shall be sufficient.

**Emergency Location Services:**

* We must integrate at least one functioning emergency beacon for locating the vehicle with sufficient location resolution to be tracked within 20m anywhere within 3km of shore.
* The emergency beacon should operate regardless of whether the UUV’s piloting computer is operational and remain always-on during any deployment situation.
* The emergency beacon may broadcast to worldwide networks, an FCC-regulated amateur radio band, or to marine specific tracking networks.
* We may install an acoustic transducer for underwater chirps to have extra redundancy for the emergency locator functions.

**Side-Scan Sonar:**

* We must implement functioning sidescan sonar capabilities onto the provided vehicle, with data preserved in a manner conducive to image analysis and exact location discovery.
* We must provide the means to correlate sonar imaging to geographic location based on predicted GPS coordinates.
* We must provide a payload computer capable of controlling the sonar hardware either through the provided Windows-based software or code of our creation.
* We must furnish the sonar system with enough memory to store full missions at the maximum (10m image distance) rate of 265MB/hr of data collection, meaning a minimum of at least 3GB dedicated memory just for sonar data to store one mission and account a memory guardband.
* The memory device should be one which is resistant to turbulence and motion-induced write or read errors, such as a solid state drive or USB flash drive.
* We should have enough available memory for at least 10 missions to reduce the need to clear memory before each deployment.

**Logistics/Power:**

* We must achieve consistently predictable mission behavior and a general piloting guideline for the vehicle, which has not yet been exhaustively tested by the NEAR lab. This will be manifested as design documentation and operating manual for all integrated components.
* We must implement a battery solution for the emergency location system(s) with at least one month of standby time.
* We must implement a rechargeable battery solution with at least 1400 Watt-hours (the nominal value of the current C-cell alkaline battery pack).
* The battery pack should offer enough power for at least 8 hours’ system operation at full system load.
* The battery pack must have a charging mechanism capable of charging the full pack in less than 24 hours.
* The battery pack must be rated to at least 200 full charge/discharge cycles.
* The charging mechanism should be current and voltage-adjustable.
* The charging mechanism may have a quick-charge feature at higher current supply.
* We may implement the new features in a way that all created deliverables are easily swappable onto the NEAR lab’s other UUV, which is a smaller vessel.

**Optional Communications Subsystem:**

* We may implement a wireless communications solution on the vehicle capable of longer-distance mission updates than the WiFi communications already onboard, for location requests and/or remote updates to mission parameters from distances greater than 75 feet. .
* We may implement this system with sufficiently high datarate to allow remote download of sonar files without AUV recovery for redeployment after image review.